NIAGARA'S PIONEERS

By

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NIAGARA'S PIONEERS

By

MERRILL DENISON 1893-

Author of

Advancing America, Great Moments in History, and Others.

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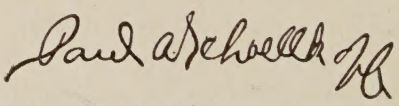
Foreword

YEAR AFTER YEAR thousands, attracted by the beauty of Niagara Falls, come from all parts of the world to marvel at this famous spectacle of nature. And having viewed the majesty of the mighty Cataract, they visit the giant power plants to see Niagara being put to work for man's use in home and industry. Almost without exception, they ask to be told the story of electric power and how it came about that man harnessed the plunging torrent. And so this book has been prepared to answer their questions by telling the story of "Niagara's Pioneers."



President

THE NIAGARA FALLS POWER COMPANY

NIAGARA'S PIONEERS

A VAST AND PRODIGIOUS CADENCE

LONG BEFORE his French companions and Indians were awake, Father Hennepin heard the sound. Borne on the light wind of dawn, it came and went on the frosty air, now only a faint murmur, yet again full bodied and strangely ominous. It was a sound no white man had ever heard before, but among the voyageurs of French Canada it had been a legend for more than half a century.

With the first light in the east, the Friar was on the trail, leading his small party towards the south, his long grey soutane swinging about his bare ankles, his small portable altar strapped to his back.

The strange sound grew in volume. The soft pad of mocassined feet gained in pace, the stolid faces of the Indians lightened; their eyes betrayed an excitement that the very earth seemed to share.

The sun rose. Louder now and more insistent, the sound grew until at last it became a deep continuous roar that seemed to permeate everything around them . . . the ground under foot, the bare branches of the trees, the frosted brambles. Even the air seemed shattered and there was a dampness as when one nears the sea.

The tall priest marched on. Whatever lay beyond would in God's mercy be revealed. In all this New World there had been nothing but the promise of great wealth and might to hold in the name of God and the French King. There was no need to falter now. The Indian guide stepped off the trail and motioned the Grey Friar to go on alone.

Down a slight incline the tall figure moved carefully until

A vast and prodigious Cadence, so great that the Universe does not afford its Parallel.

he reached a tangled overgrowth of young trees. He thrust aside the branches and stepped out on a little plateau.

Below him lay white tumbling waters, delicate rainbow mists, green pools of beauty, and thundering terrifying power, such as only God could have conceived. Power matched with beauty, majesty with might . . . the miracle of Niagara Falls.

Father Hennepin dropped to his knees. He gave thanks for his safe journey across the seas from France and through the wilderness to this greatest of all moments.

Rising, he unstrapped his small altar, prepared it for the Mass and French voices singing a Te Deum mingled with that of the mighty cataract.

It was the morning of December sixth, 1678.

Thus Father Louis Hennepin, missionary to New France, came upon the Falls of Niagara. Years later he wrote this description,

> *"Betwixt the Lakes of Ontario and Erie, there is a vast and prodigious Cadence of Water which falls down after a surprising and astonishing manner, so much so that the Universe does not afford its Parallel."*

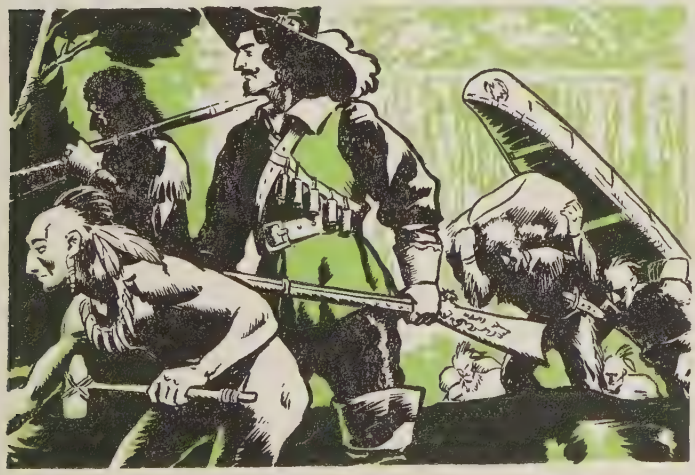
A TOIL PRODUCING OBSTACLE

FATHER HENNEPIN passed on and after him came other French: the priests, the soldiers and the traders. Black robed Jesuits to teach the Indians the way of God. Detachments of Royal Regiments to hold the land for France. Coureurs de bois in shirts of beaded doeskin to collect the furs of the interior.

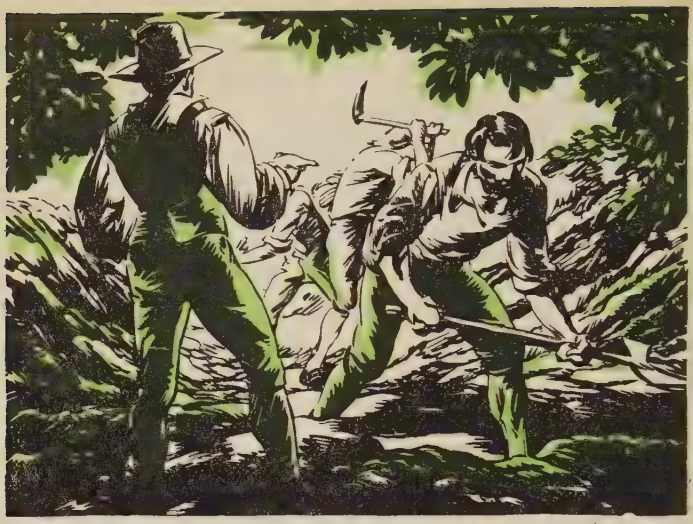
And a new sound was heard in the ancient forests: the sharp ring of steel against the tree trunks as the French cut out a portage road around the mighty cataract. At the mouth of the Niagara River they built a fort and marching on to Lake Erie built others to begin the far flung chain of outposts which would stretch from Quebec on the St. Lawrence to the mouth of the Mississippi.

But to the Frenchmen who toiled over the portage, packing heavy loads, the Falls soon ceased to be an awe-inspiring spectacle. To most of them it seemed little better than a monstrous prank of nature, a useless toil-producing obstacle to trade and navigation.

To all save one man, a French Canadian trader, Chabert Joncaire, who bore the splendid title of *Master of the Portage,* and *Dictator of the French Government's Trade with the*



Across the Portage Road from Lewiston toil French and Indians.



Chabert Joncaire digs himself a ditch, a puny mill race . . . six feet wide and four feet deep.

West. Joncaire arrived at Niagara in 1748 and to him, first among all men, the vast and prodigious cadence was more than a breath-taking spectacle or an obstacle to shipping.

To Chabert Joncaire, the Falls meant power. Could he but harness a minute fraction of their stupendous force, the waters of Niagara would work for him, would saw timbers straight and smooth, the timbers to build ships that would keep the fleur de lys flying on the Upper Lakes.

And so Joncaire dug himself a ditch, a puny mill-race, no more than six feet wide and four feet deep. It took water from above the Falls, curved inland and soon rejoined the racing torrent. At the point of discharge, Joncaire constructed a clumsy, overshot water wheel to drive a saw mill.

For the first time, Niagara had been put to work. For the first time, the Great Cataract was lightening man's labours.

All traces of Joncaire's small canal have disappeared but the foot of First Street in the City of Niagara Falls, New York, marks the exact location of his six foot mill dam.

Even this obscure memento of a forgotten Frenchman is one of the most significant in all America today. Joncaire presaged man's conquest of Niagara; man's use of its tremendous power.

THE FRONTIER RECEIVES NEW MASTERS

BUT THE years Niagara worked for Chabert Joncaire were few. Before long Quebec fell to General Wolfe. Soon the tramp of scarlet coated infantry was heard along the portage road around the Falls. Niagara had passed into the domain of His Britannic Majesty, King George III.

To the Portage as its new master came John Stedman, retired sergeant of the British Line. He cleaned out the small canal, improved the saw mill, built himself a home and cleared the land. It was Stedman who placed goats on Goat Island, thus giving it the name it bears today.

For nearly thirty years, the British were overlords of the great river and the Falls. Then war came to North America again, this time between King George and his rebellious colonists. When it was ended, the red-coated British garrisons ferried themselves across the troubled waters of Niagara to build new forts on the Canadian shore.

Soon after, the old portage road around the Falls echoed to the footsteps of a different breed of men. Not soldiers this time but Americans come to discover the continent they'd won with their independence.

They came from the east by way of Lake Ontario or along the ancient route of the Indians: the Mohawk Trail; young men with the certainty of freedom in their hearts and the promise of the future in their eyes.

Some came to see the Falls, already famous throughout America and Europe, and returned east when they had drunk their fill of beauty. Others paused briefly, as Hennepin had done, on their way to explore the great, unknown west that lay beyond. But there was one who came and stayed, one for whom the descent of the great waters held an especial fascination; Augustus Porter, a twenty-six year old surveyor from Connecticut. To Porter the Falls meant power; power enough to turn all the mill wheels in America.

Porter had come west with a surveying party bound for the Ohio country. He remained to become one of Niagara's pioneers. With his younger brother Peter, he leased the old Portage Road from the State of New York; improved the

Augustus Porter dreams of making the Falls serve some useful purpose . . . of putting their wasted energy to work.

grade and widened it; replaced the Indian pack-carriers with carts and horses.

Under the brothers' management, the old French road became an important link in the trade route between the east and west. The carrying business thrived and before long the Porters were building huge warehouses at Lewiston and on the upper river, and operating fleets of sailing vessels on Lake Ontario and Lake Erie.

But Augustus Porter's interest was more in the Falls themselves than in the busy road that led around them. He dreamed of making them serve some useful purpose, of putting their wasted energy to work.

So it was, when the State of New York sold at Public Auction in 1805 the lands along the Niagara River, Augustus Porter and his friends bid in the lots which embraced the American Falls, the rapids above them and the beginning of the Gorge below. At the same time they bought a number of lots between the Falls and Buffalo. With the title to the land went the riparian rights and the title to the water power.

Once his ownership was confirmed, Porter sought to give substance to his dream, the dream that had been with him since coming to Niagara eleven years before. In 1806, he built a grist mill with two run of stone on the very site of Joncaire's

first saw mill. The Frenchman's canal had filled with silt, so Porter dug a new mill-race, but the two mills occupied the same position. Two years later, he erected a rope walk and a tannery.

Such were the modest industrial beginnings of the village of Niagara Falls. Father Hennepin's prodigious cadence was at work; feebly it is true, but enough to serve the needs of the tiny pioneer community and to point the way to the further harnessing of the river's plunging might.

But again war swept across the Frontier, this time with a new intensity. From 1812 to 1814, the Peninsula became an armed camp from Buffalo to Fort Niagara at the river's mouth, and from Fort Erie to Missisauga. Bloody battles were fought at Chippawa, Lundy's Lane and Queenston Heights; the villages on both sides of the river were laid waste and most of the forts destroyed.

But when peace came again, it was to remain from that time to our own. On the day before Christmas, 1814, Great Britain and the United States signed the Treaty of Ghent and later pledged each other that never again would there be an armed vessel on the Great Lakes between the United States and Canada.

From 1812 to 1814 the Niagara Peninsula becomes an armed camp on both sides of the River.

NIAGARA GOES A-BEGGING

THE PORTERS' carrying business, ruined by the War of 1812, grew rapidly once peace returned. Over the Portage Road were transported all the goods and materials that moved up the Hudson and Mohawk Rivers to Oswego, along Lake Ontario and around the Falls to Erie. In one year alone, 1816, 16,000 barrels of salt passed between Lewiston to Buffalo at a forwarding cost of $2.00 for each barrel.

To a great extent, the very success of the Porters as forwarding agents helped bring to an end the old road that ran past the Falls. For the Porters helped materially to open up the western country, to settle Ohio, Illinois and Indiana, and from these new states came a growing demand for an easier, cheaper means of transportation to the east.

Begun in 1818, blasted out with black powder and dug with pick and shovel, the Erie Canal was completed in 1825. The Porter Brothers were among those who attended the official ceremonies and made speeches of congratulation. Signal cannons stationed a mile apart the whole length of the new waterway carried the triumphant news of the opening from Buffalo to New York.

But while the booming cannon, echoing down the valley

Signal Cannons carry the news from Buffalo to New York

of the Mohawk and the Hudson, sounded a pean of promise for the future of America it was also a requiem for the Portage Road that had served for almost 150 years. As soon as the Great Ditch across New York State was opened, all traffic moved along it and the old Portage trail first worn smooth by the moccasined feet of Indians became weed grown and abandoned.

As in his youth, the elder Porter turned again to the Falls. He had constructed a bridge to connect Goat Island with the mainland, laid out paths and built a lookout which commanded the full sweep of the tumbling waters, the mists, the foam flecked pool below. To this lookout he came to ponder.

Through these waters he had made and lost a prosperous business. What did the future hold? The roar of the cataract answered, giving him nature's challenge to man.

Could he meet it? Could he tame this unbridled power? Had he the ability, the courage, the indomitable purpose?

The waters swept past but their roar was now a prelude to man's acceptance of the challenge.

The power created at Niagara was his and his friends by virtue of letters patent issued by the Sovereign People of the State of New York. If they could develop this power, a prosperous manufacturing center would arise around the Falls. They needed one thing, however, before they could even move toward giving substance to their dream. That thing was capital.

Where to obtain it? No reserves of wealth had yet accumulated along the Frontier. There had not been time. The region was too young, too undeveloped. And so the two brothers, Augustus and Peter, sought elsewhere. In 1825 they extended an "invitation" to "Eastern Capitalists and Manufacturers" to join them in a large scale development of their potential power site.

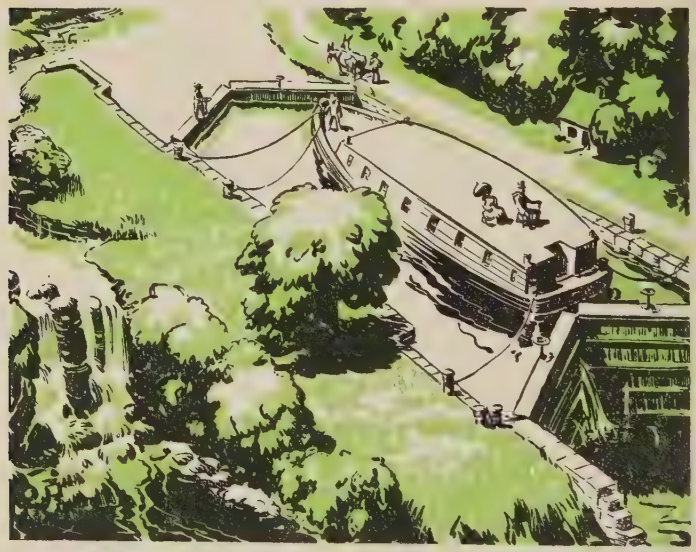
Written in the polished language of the period, the "invitation" stated: *"the inadequacy of capital in this part of the country for undertakings of this kind, added to the doubts which until very recently existed in regard to the success of American manufacturing generally, has hitherto prevented improvements which this situation so powerfully invites."*

Yet the Porters, wild visionaries though they seemed to the people of their day, did not propose to make use of the great cataract itself, but only of the Upper Rapids, where the river drops some fifty feet in three quarters of a mile. They were concerned alone with water power. In 1825, scientists were only beginning to turn their attention to the mysterious force known as electricity.

The "invitation" went a-begging. Capital could find employment without turning to hairbrained schemes like this one, far off on the distant Niagara Frontier.

To men with money to invest, the new towns growing up along the Canal — Rochester, Lockport, Utica — offered much more attractive possibilities. There, well disciplined, manageable water power was available in any conceivable quantity that manufacturing could use.

Having failed completely in the first attempt to find others who could share their vision, the Porters waited, implanting in their sons their dream of the great river harnessed to the needs of men.



New towns along the Canal offer manageable waterpower in any conceivable quantity that manufacturing can use.

A NEW PROPOSAL

IN 1847, Augustus Porter, now seventy-eight years old, issued a second invitation, this time by himself, for his brother Peter had died three years before. Like the first invitation the second was addressed to "Eastern Capitalists and Manufacturers."

This was a much more ambitious scheme than the first. The earlier one had proposed nothing more than the building of a series of mill-races like Joncaire's to supply small mills strung out along the river bank above the Falls. Now, Porter envisaged a canal big enough to supply water power for the largest industries then known; a canal which would feed water to a huge reservoir or terminal basin perched on the top of the high bank above the Gorge.

But Augustus Porter was again doomed to disappointment. Because it was more ambitious, the new scheme provoked even more skepticism than the first. The old pioneer died in 1850 at the age of eighty with his great dream still unrealized and the stupendous energy of Niagara as yet unharnessed.

But the Niagara Falls were acquiring fame throughout the land. The railroads had already reached the small town built near them and thousands of visitors arrived each year to marvel at the splendor of the cataract. There were two fine tourist hotels with 100 rooms each and by 1850 they were already calling the town "The Honeymoon Capital." There was even talk of building a suspension bridge across the Gorge below the Falls.

When the bridge was finally commenced, the engineers offered a prize to any one who could run a line from shore to shore to haul the cables across the deep crevasse separating Canada and the United States. Days passed and no one came forward to offer a practical suggestion. And then, one windy morning, a small boy appeared with a kite and a huge ball of string. While the bridge builders looked on, the boy sent his kite aloft, manoeuvred it across the river and allowed it to settle on the Canadian side. He won the prize.

Among those who came to view the wonder of Niagara at that time were Walter Bryant, representing a former mayor of New York, Caleb S. Woodhull, and Stephen Allen, a well known engineer from Boston. After lengthy negotiations Bryant agreed with the Porter heirs to build the ambitious canal proposed by the old patriarch, Augustus, two years before his death. Allen was retained as the consulting engineer.

A company was formed in 1853 and $500,000 was finally raised and spent; some of it to purchase lands and rights of diversion from the Porter heirs, but most to blast away the hard limestone rock for the canal.

But the company ran out of money and for three years the big ditch lay abandoned until a new company was organized with Stephen Allen as President and Horace H. Day as Treasurer. Again capital was found for the heartbreaking enterprise. This time work went faster than before.

These new builders had something to help them that their predecessors lacked. Dynamite had been invented and with the new explosive to blast away the limestone rocks, the canal took shape, the intake basin was constructed above the rapids, and on July 4th, 1857, water trickled into the still uncompleted race way.

That year Stephen Allen composed a patriotic address to honor both Independence Day and the progress of the Hydraulic Canal. It was delivered with appropriate ceremonies.

During the succeeding twelve months the Canal was cleaned out and deepened and when it was again time to celebrate the Glorious Fourth, a waterfall of respectable proportions was flowing over the top of the high bank.

This time the town of Niagara Falls celebrated with a fervor that was long remembered. To the newly completed intake basin at the entrance to the Canal came three excursions steamers in procession from Buffalo up the river. There were military bands, volunteer fire companies from as far away as Utica, and two barges bearing 32 beautiful girls, in costume and holding aloft patriotic parasols, representing the 32 States of the Union.

Mr. Allen delivered the address he had prepared the year before but this time no one heard a single word. The

Bands, fire companies and two barges bearing 32 beautiful girls representing the 32 States, sail down the Niagara.

speaker's voice was drowned by the roar of the Falls, the joyous whistles of the steamboats and the cheers of the delighted multitude. With the intake basin completed at one end of the Canal and water spilling out the other, the townspeople of Niagara Falls were satisfied that the industrial future of their community was at last assured. "Gus" Porter's dream of half a century seemed to be coming true.

But Allen and Day, like Bryant and Woodhull before them, came to grief through lack of sufficient capital. In 1860, with the Canal still useless from a commercial standpoint, Day took over the old company, reorganized it, and prepared to complete the job.

Like his predecessors, Day was doomed to failure. The Civil War came and with it the stagnation of all unproven industrial undertakings. Although he poured hundreds of thousands of his own money into the completion of the Canal, it was not until 1875 that it won its first commercial customer. In that year Colonel Charles Gaskill, retired army officer and veteran of the Civil War, built a grist mill on the high bank beside the terminal basin.

Even this belated promise of a better future came too late. By this time Day had expended most of his money, and had mortgaged the land and water rights owned by his company. Early in 1877, the creditors closed down, a mortgage foreclosure was threatened, and the Sheriff of Niagara County stepped in to put under the hammer the Canal and land and water rights, to which Horace Day had given without stint his time, his energy and fortune.

A WHITE ELEPHANT CHANGES HANDS

AT 11:30 on the morning of May 1, 1877, a small group of frock-coated gentlemen gathered in the parlor of the Spencer House in Niagara Falls, New York.

At 11:35 the auctioneer mounted a low platform and invited bids.

There was complete silence. The auctioneer began again, exhorting the gentlemen present to speak up, reminding them of the money already spent on the Canal; assuring them that little more was needed to place it in operation.

The first reluctant bid was made: $5,000. The auctioneer smiled pityingly. Another bid: $20,000. The auctioneer implored the gentlemen to stop joking and be serious.

A third bid: $67,000. It came from a man known to most of the 35 or 40 in the room; a prosperous manufacturer from Buffalo, Jacob F. Schoellkopf. Schoellkopf was respected for his shrewd business judgment. As a young German immigrant of twenty-five he had arrived in Buffalo in 1844 with a capital of $800. Starting with a small leather shop, he had bought an interest in a struggling tannery, put it on its feet, sold it and bought another. Venturing cautiously

"What am I offered, gentlemen? Half a million? . . . $250,000?"

at first, then more boldly, he built up his tiny capital, acquired tanneries in Buffalo, Milwaukee and Chicago, became interested in flour milling. By 1877 he was one of the leading business men of Western New York.

In view of his reputation for good common-sense, his bid seemed all the more amazing. Eyebrows were raised; and men whispered to each other. Was Schoellkopf slipping; could success have gone to his head? Even the auctioneer was doubtful. Mr. Schoellkopf repeated his bid: $67,000. The auctioneer cried it until it was time for luncheon.

"Sixty-seven thousand dollars—"

"Sixty-seven thousand dollars—"

In the dining room of the Spencer House, Horace Day did his best to convince the others of the potential value of the property. He told them how he alone had invested $700,000; the company before him nearly $300,000; its predecessors more than half a million. Day's small audience listened; polite but unimpressed.

When bidding resumed after luncheon, there came a surprise bid of $67,100, a raise of $100. This was still considered too low and the sale was adjourned for another hour. At half past four the auctioneer received a bid of $71,000 from Jacob Schoellkopf. It, too, was cried until the auctioneer's voice was worn to a feeble creak. Exhausted and exasperated, he launched into his final exhortation. . .

"Seventy-one thousand dollars! Going once! Going twice! Going three times! And sold to Mr. Jacob Schoellkopf for $71,000!"

There was a round of cheers. The Hydraulic Canal had passed into the hands of a new owner, the fourth since it had been started twenty-five years before.

What luck will the fourth owner have with it? Can he succeed where Woodhull, Allen, Day and their associates had failed? The gentlemen who were at the auction wonder as they go their several ways. And there are others who wonder too! The ghosts of the men who have gone before—La Salle and Father Hennepin; Joncaire and Stedman; Augustus Porter and his brother, Peter; all the vanished Indians and French and British who once toiled under heavy packs up the heights of Lewiston and across the old Portage.

THE FIRST HARNESSING OF NIAGARA

"WELL, MOTHER, I've bought the canal," boomed Jacob Schoellkopf, when he arrived home that evening.

"Jacob, Jacob," his wife protested softly, "you'll bring ruin on us yet with your crazy schemes."

The response of his partner in the flour-milling business, George B. Mathews, was not much more encouraging. "What'll you do with all that water, Jacob?" he demanded. "You can't use it and you can't sell it."

Others shared the pessimism of Schoellkopf's wife and his milling partner. It seemed impossible that anyone would ever tame the white torrent of Niagara. The only encouragement, in fact, came from the Village of Niagara Falls itself, whose residents knew that its future depended upon the Buffalo manufacturer's success. Already the State Legislature had passed acts in 1871 and 1872, authorizing the Village of Niagara Falls to enter into agreements with the canal owners regarding the building of bridges. A further act passed in 1875 confirmed the earlier statutes and the development of power was firmly linked with the industrial future of the community.

But despite Schoellkopf's reputation in business and investment circles, a year passed before funds could be secured to complete the canal. In 1878, however, the fourth company, The Niagara Falls Hydraulic Power and Manufacturing Company, was formed, and efforts begun to secure new customers for its water power.

By 1882, Jacob Schoellkopf and his associates had enlarged the Canal, built a small power house, known as Station One, and were furnishing seven mills with water power. Substantial progress had been made at last. For the first time the Village of Niagara Falls had definite promise of becoming an industrial as well as a tourist center.

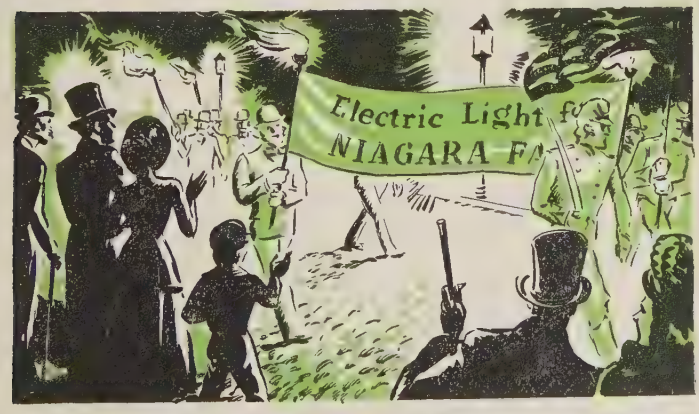
Until 1881 there was no thought of electricity in connection with Niagara. All the mills were run by direct water power operating clumsy water turbines which in turn drove machinery by means of shafts, belts and pulleys. And then, toward the end of that year, occurred an epochal event: the

installation of an electric generator by the Brush Electric Light Company to be driven by mechanical power furnished by the Schoellkopf Company.

Up to this time electricity had few commercial uses except to operate telegraphs and telephones. The principle of the direct current electric motor had been accidentally discovered only eight years before. Less than two years had passed since Charles Brush had perfected his open arc light and Edison the incandescent lamp. The genius of Menlo Park had still to design his Jumbo generator and build the first central power station. For most practical purposes, electricity was still the problem child of the scientist and the research laboratory.

The Brush generator was among the first built in the United States. Driven indirectly by Niagara's power it produced enough current to operate sixteen arc lights and so great was the interest in those new scientific marvels that railroads ran excursion trains to see them. When the lights were first turned on the town of Niagara Falls celebrated the illumination with a great torchlight procession through the streets and the customary booms of cannons.

Niagara's era of electricity had dawned. The pioneers and dreamers of the early days were to give way to the scientists, inventors and engineers who would some day master the unknown art of widespread distribution of this new servant of mankind.



The town of Niagara Falls celebrates the first arc lights with a procession through the streets.

ANOTHER PLAN

WITH THE success of the Schoellkopf operations, the first long period of pioneering was ended, the practical use of Niagara's water power successfully demonstrated.

But a new problem soon arose: that of factory locations for the use of the water power available. The Schoellkopf development got its water from a surface canal as projected by Augustus Porter. It ran overland through the Village of Niagara Falls, and since it furnished power only at its point of fall, its capacity was obviously limited.

This problem of finding power sites was made still more acute by the creation, in 1883, of the New York State Reservation at Niagara Falls, which set aside Goat Island and a strip of the river bank above and below the American Falls as a public park. The heirs of Augustus Porter received $1,439,423 for their lands, one of the world's most famous parks was created, but the number of possible power sites was greatly restricted.

And then, eight years after Jacob Schoellkopf and his associates had taken over, a new group of trail-blazers proposed a more audacious plan than any yet considered.

Thomas Evershed, a division engineer on the Erie Canal, suggested the building of a gigantic tunnel to run for more than a mile beneath the town of Niagara Falls. The tunnel was to serve as a tail-race for factories located on the surface of the ground above it. These factories would draw their water from the upper river by a series of small surface canals, and after using the water to turn their wheels and turbines, would discharge it into the great tunnel below.

The scheme immediately fired the imagination of a group of business men who proceeded with plans for the building of a plant which would compete with the existing plant of the Schoellkopf group. In 1886, the Legislature granted the new group a charter to form the Niagara River Hydraulic Tunnel Power and Sewer Company.

But history again repeated itself and it took three years to obtain the financial resources demanded for so costly an engineering project. Not until 1889 was the new company

in a position to enter into a contract with the Cataract Construction Company for the building of the Great Tunnel. At this same time the Tunnel Company became known as The Niagara Falls Power Company.

But the very scope of the Evershed plan threatened for a time to be its undoing. The projected tunnel was to be the greatest engineering work of its kind ever contemplated and required the solution of many problems. The unique nature of these problems made more hazardous the financial aspects of the undertaking.

Before embarking on such an astounding venture, any group with the necessary resources required assurance that their plans had the full approval of the State. This approval was granted by various acts and amendments passed by the Legislature of the State of New York between 1886 and 1893 which enlarged the corporate powers of the Company and affirmed its right to take water and use it for power purposes.

But even when the People, through their elected representatives, had blessed the enterprise with legislative guaran-

Thomas Evershed proposes a more audacious plan than any that has gone before.

tees, there still remained two baffling questions. One, how best to develop the enormous quantities of power to be made available by the subterranean tunnel. Two, how to find a market for this power when developed.

Obviously the town of Niagara Falls with a population of 3,500 persons could not be expected to consume but a fraction of the potential output. Twenty miles away, however, was the city of Buffalo with a quarter of a million inhabitants. A great market, but how was the power developed at Niagara Falls to be transported twenty miles to Buffalo?

In 1890 no way was known. All over the world the power of falling water was still being used as it had been since the days of the Egyptians: to turn wheeels which ran machinery by means of shafts and belts and pulleys. A few electrical generators were being driven by water power, it is true, but the installations were mainly experimental. Furthermore, no one had yet discovered a way to transmit electrical energy more than a mile or two from the point of manufacture.

With the hope of stimulating discovery, public spirited citizens throughout the country offered a prize of $100,000 for a plan to solve this baffling problem of power transmission. Those directly interested in the Evershed scheme also tried to find an answer to the unsolved riddle by inviting scientists and engineers to submit opinions.

No solution was forthcoming, however. A number of schemes were proposed. Some called for transmission by compressed air; some by water, piped under pressure; some by electricity, but none was practical.

Out of the preliminary search for a solution, nevertheless, came two important and far reaching decisions—the first was to retain the Evershed plan of a subterranean discharge tunnel *but to develop power at one central station;* the second was *to generate that power in the form of electricity.*

Today, when hydroelectric plants are common throughout the world, when electricity is almost as important to modern life as the air we breathe and when it can be transported economically hundreds of miles, it is almost impossible to realize the unprecedented nature of these two decisions or the daring it took to make them.

DIRECT OR ALTERNATING

IT WAS one thing to decide to generate electric power, another to determine how best this could be done, and still another to find the means to distribute it over large areas. For in 1890 the science of electrical engineering was still in its infancy, comparable, say to railroading in the 1830's or to the automobile in the early 1900's.

Ordinarily a new science progresses slowly, invention building on invention until the advanced technology evolves. What those interested in the Evershed plan proposed was to attain the advance in a single prodigious leap.

Needing the advice of best experts available, if their amazing plans were to have any promise of success, the Evershed group organized a research and consulting board known as the International Niagara Commission composed of eminent American and foreign scientists and engineers.

Meeting in London the Commission invited engineers in all countries to submit plans for (1) the best hydraulic development; (2) the best system of electrical distribution; (3) the best combined project for hydraulic development and electrical distribution.

No plan submitted was of sufficient merit to win the grand prize. Smaller prizes were awarded, however, among them one for the best hydraulic development. It led to the beginning of work on the Great Tunnel, to run at a depth of more than 100 feet below the town of Niagara Falls and extending a distance of 6,700 feet from a point more than a mile above the Falls to its discharge in the Gorge below.

But the competition did little to promote the long distance transmission of electricity. The International Niagara Commission dissolved; its members, in common with scientists the world over, could not agree on one of the most hotly debated engineering questions of the day: the relative merits of direct and alternating current.

Direct current had already proven its value under certain conditions but it could not be used commercially to transmit current for more than a mile or so.

Alternating current, on the other hand, was virtually untried—but fascinating in its possibilities.

To make a personal survey of the state of power development abroad, Edward Dean Adams, President of the Cataract Construction Company and Dr. Coleman Sellers, a distinguished American engineer, travelled through Europe during the summer and fall of 1890.

In Geneva they saw water power being distributed by pressure through a pipe system. It was mechanical hydraulic power, however, and could be delivered less than a mile. In Berlin, they examined a 1,000 horsepower direct current generator. But again the Berlin transmission distance was only a half a mile. At Budapest, they inspected a 1,000 horsepower alternator then under construction. Driven by a steam generator its use was limited to arc lighting.

The further Adams and Sellers travelled, the more certainly did their trail seem to point to the use of alternating current. But where were they to assure themselves it was the answer? How were they to make certain that it was the solution to their problem?

The trail faded as European electrical experts shook their heads at the "visionaries of Niagara," the men who talked about tens of thousands of customers, of cities to be lit, of factories and street car lines eager to secure large blocks of power, "of Buffalo, with a quarter of a million, only twenty miles away."

One of the drawbacks to electrical transmission concerned the high voltage or pressure required to carry it 20 miles. Until this difficulty could be overcome Buffalo might just as well be 200 or 2,000 miles away.

Returning home, the two men believed there might be one way out of the impasse. By using transformers to raise the voltage for transmission purposes and, on the other end of the line, other transformers to reduce it for commercial use, they *might* find the key to long distance transmission of power — the key to the door that had never yet been opened.

This belief in alternating current was based almost entirely on theory and opposed to its use at Niagara Falls were such outstanding figures as Lord Kelvin, one of the world's greatest physicists, and Thomas A. Edison, the electrical wizard who had done so much to explore the new form of energy.

On the other hand, leading engineers and scientists, who had been studying the problem, such as George Westinghouse, inventor of the air brake; Professor George Forbes of London; Lewis B. Stillwell of the Westinghouse Company; William Stanley, who developed the transformer; Nicola Tesla, inventor of the polyphase alternating current system and motor; and other men felt that alternating current offered the only practical method of transmitting power over relatively long distances. These men were willing to assist in the development of such a system to prove that it could be successful for transmission of electrical power over distances far in excess of those possible with direct current or mechanical transmission systems.

Nevertheless it required superb courage to make the final decision that would launch the Company on its great experimental venture. But the story of Niagara is the story of unusual men—men who had the courage to assume great risks and the persistence to struggle on against odds which seemed unbeatable at the time.

So it was that the Company decided to install alternating current dynamos, have transformers developed, and erect the necessary transmission system to carry power in large quantities to Buffalo. The orders were given in 1893 for machinery and equipment greater in size and capacity than any

The work of boring out the Great Tunnel progresses slowly.

similar apparatus ever made—three 5,000 horsepower generating units.

In the meantime another spectacular task was nearing completion . . . the building of the Great Tunnel. New engineering problems had been met every few hundred yards, new difficulties surmounted. But finally the job was done and the world's three largest generating units installed. With the stringing of transmission lines, the day approached for turning on the power, for determining whether Edward Adams and those who worked with him had built with folly or wisdom.

On November 10, 1896, the city of Buffalo went en fete. That night electric power generated by the falling waters of Niagara was to flow through *twenty miles* of wire to the city on Lake Erie.

Would the miracle be accomplished? They wondered.

Young men's eyes glowed with the promise of the future! Old men shook their heads — they had seen too many schemes start and end to be stampeded now!

A small group of men stood together, waiting—Adams and those who had his vision.

Two minutes now before midnight . . . a minute!

Fifty seconds . . . Thirty seconds!

At the first stroke of midnight, Mayor Jewett threw a switch. Along twenty miles of wire stretching from Niagara Falls came the pulsating current.

"The power is here," the Mayor cried. The street lamps glowed with light, the crowds cheered, and, as always, cannons boomed a national salute.

But the smiling Mayor did not make the announcement for the City of Buffalo alone. He proclaimed to the whole wide world that light and power could be carried into every home, that one of the greatest boons of mankind had been given to the world by Niagara's Pioneers.

IN THE WAKE OF POWER

THE MARCH of progress brings first the explorers, then the pioneers, then the men of purpose who shape the future destiny of a community, and finally industry. Communities cannot prosper without industry and modern industry cannot prosper without cheap power. Industry inevitably gravitates to the places where it is found.

So it was with Niagara. Once available, low-cost electricity quickly attracted industry. Between 1890 and 1900 the population of the City of Niagara Falls increased from 3,300 to 19,500; between 1900 and 1910 it advanced another 57 percent against advances of 20 to 25 percent for the state and nation as a whole. With the coming of power, new industries were created; industries which required plentiful supplies of low-cost electricity and without which they could not possibly exist. The electro-metallurgical and the electro-chemical fields are examples.

Large scale production of three of today's most widely used commercial products—carborundum, aluminum and calcium carbide—was made possible by the development of cheap electric power at Niagara Falls. Edward G. Acheson, inventor of carborundum; Charles M. Hall, discoverer of the electrolytic process for the recovery of aluminum from its natural ores; Thomas W. Wilson, inventor of calcium-carbide from which acetylene is made—all these men had perfected their processes experimentally but in each case high production costs prevented manufacture in commercial quantities. Niagara's electric power made these products available to the world at large.

These men, along with Hamilton Castner, inventor of the electrolytic cell for producing caustic soda and metallic sodium, were among the first to follow the trail to Niagara where abundant power permitted economic manufacture on a quantity basis. These are no longer pioneer industries, and the plants, attracted to Niagara Falls to produce their products alone, give employment to thousands in supplying Industrial America with a large part of its basic materials.

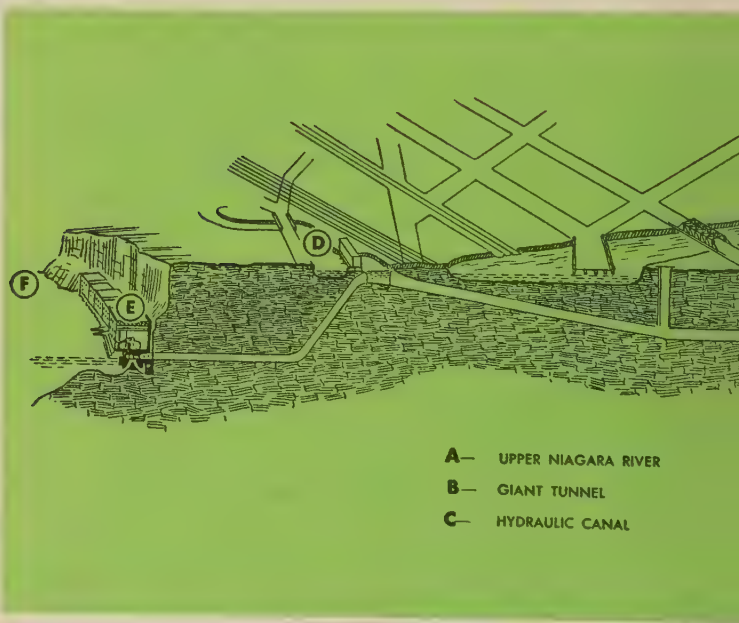
Other industries sought the boon presented by cheap power. Manufacturing processes—whose very commercial

existence depended on the availability of low-cost electricity —located at Niagara. There, guaranteed by long term contracts, they were assured the supplies of power needed to justify the investment of millions in manufacturing plants. Under the stimulus of Niagara power, great industries were born, grew and prospered, creating new wealth and pouring taxes into the public treasury.

A new day had dawned. The challenge of the Falls had been met, the dream had come true.

Disappointment, heartache and struggle had been translated into accomplishment. Beauty had been preserved, the beauty of purpose added.

Now the white spray, the green pools, the thundering majesty of tumbling waters were serving man, lightening his work, promoting his happiness. Enriching the nation too, creating industrial prosperity for the Niagara Frontier communities—a prosperity which in turn flowed out into the State and the Nation in the form of economic wealth.

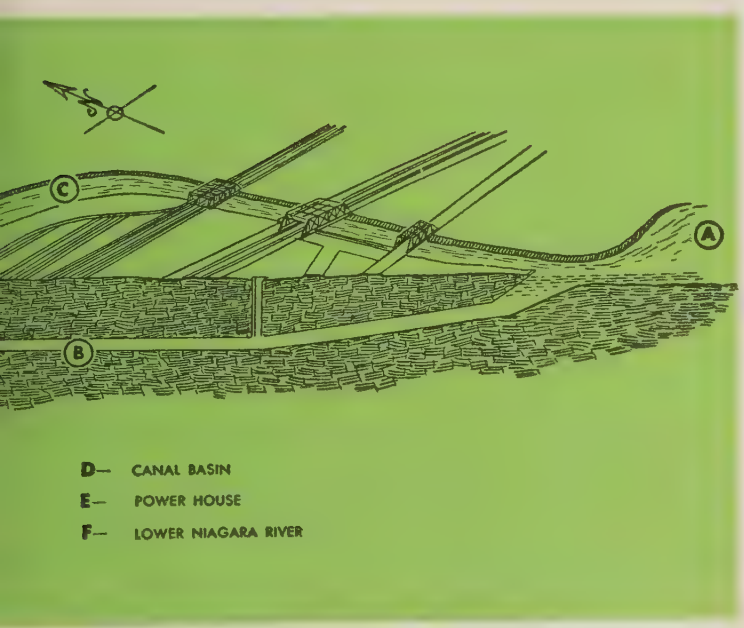


Water is routed through two diff

THE YEARS OF GROWTH

AT THE dawn of the new century there were two chief sources of Niagara power: (1) The Edward Dean Adams Station, (which had triumphantly led the way to the use of alternating current) and (2) Station 2 of the Niagara Falls Hydraulic Power and Manufacturing Company, (originally the Schoellkopf Company), built in 1896. In that year the latter Company had increased its power development following the enactment of a statute by the State of New York which limited the amount of water which might be diverted for power purposes, but which also confirmed and defined the Company's riparian rights.

The Schoellkopf Company completed a second station in 1904. It had the unprecedented capacity of 34,000 horsepower but even this output failed to satisfy industry's growing appetite for electricity. Again the Company responded to the cry for power and more power. And this time it was



nels to the Schoellkopf Station.

determined to undertake no half-way measures. Its new station was to have a greater capacity than the world had ever dreamed of; thirteen units whose spinning turbines, driven by the dynamic force of the rushing waters of Niagara, would produce 130,000 horsepower. The new plant was rushed forward to completion. New penstocks were built to guide the flow of water to the turbine wheels . . . and out over the transmission lines pulsed more current to banish night and make men's daylight hours more productive.

As early as 1883, the State of New York had assumed responsibility for Niagara's scenic grandeur by the creation of a Park Reservation which included the American Falls and the adjacent islands. Before the completion of the giant 130,000 horsepower plant, the Federal Government, with jurisdiction over the Niagara River as an international boundary stream, began to regulate the amount of water which might be diverted for power purposes. A Federal licensing system was instituted and the two competing companies were alloted limited quantities of water.

A few years later, in 1910, the beauty of the Falls was further preserved by a treaty between the United States and Great Britain. In it the two countries agreed to restrict the quantity of water each could divert for power purposes but to do so in a manner which would cause the least possible harm to the huge investments already made in the hydro-electric plants on both sides of the river. With the joint aim of beauty and utility in view, the treaty provided for a diversion on the American side of 20,000 cubic feet per second.

And then . . . April 1917! For the fourth time in its history the Niagara Frontier heard the call of war. This time the call was more distant than before. No armed forces faced each other across the turbulent waters for now Americans and Canadians fought a common enemy. But the effect of this war on the Peninsula was greater than in all preceding ones.

In scores of plants and factories, some new, some long-established, were produced materials essential to modern warfare: the foster children of electricity — carborundum,

chlorine, titanium, aluminum, vanadium, carbides, alkalis and a host of chemicals, metallurgicals and abrasives. In the throes of the national emergency, with every effort being made to key America to new pinnacles of productivity, the industries dependent on Niagara's power assumed critical importance.

From our own government and from our allies overseas came orders for the materials without which modern war could not be waged. Production was speeded up, reached and passed successive peaks, and still the demand came for greater output. Week on frenzied week, the curve of power consumption climbed toward the point where the allotted 20,000 cubic feet per second would no longer prove adequate to meet the insatiable needs of war.

As the curve mounted up and up toward its climax point, that point at which a power shortage must result, the Secretary of War asked all the producers, including the Schoellkopf Company (now the Hydraulic Power Company), and The Niagara Falls Power Company, to improve and increase to the utmost the efficiency of their generating facilities.

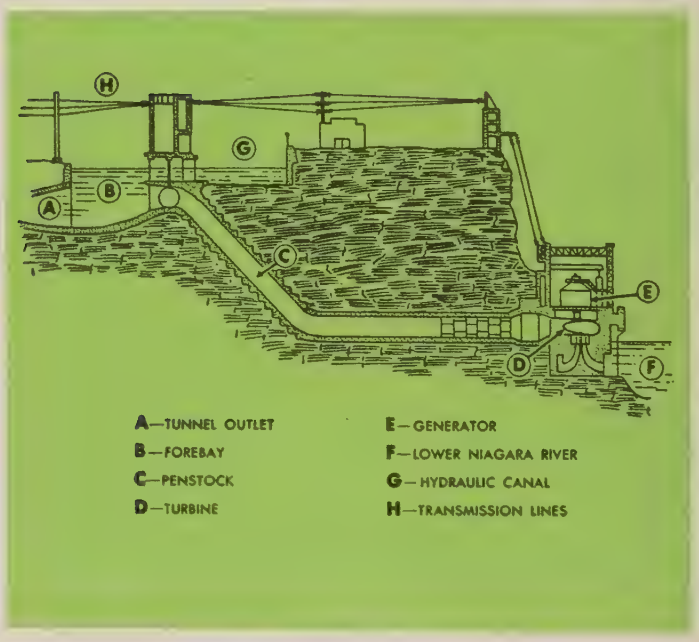
Engineering studies were immediately undertaken. Working day and night, engineers, technical experts, scientists and government consultants pooled their abilities and submitted for the government's approval, a plan which called for the consolidation of all the generating and distributing companies; rivals no longer under the mad stimulus of war.

The report was adopted and in May 1918 legislative authority was granted for the two great companies to consolidate and form the present The Niagara Falls Power Company. Formal approval to the consolidation was given by the New York State Public Service Commission on October 24, 1918. Thus were joined the two lines of Niagara's development.

Following the formation of the single company, the Federal Government passed the Federal Water Power Act on June 10, 1920. This act established the Federal Water Power Commission with authority to issue licenses, of not more than 50 years duration, to develop and manufacture hydroelectric power in or from the navigable waters of the United States. At the present time The Niagara Falls Power Company is using 20,000 cubic feet per second under Federal

license; 19,725 feet per second of this is under a license which expires in 1971, and 275 feet under a temporary license.

In the decade following the war, domestic uses of electricity increased enormously, and electricity, whether made from steam or falling water, became the common form of power throughout industry. To meet new industrial demands, other electric plants through New York State were developed and expanded. So that their reserves of power could be pooled, local transmission lines were joined together, and the companies which owned them, consolidated. Gradually the size of the integrated units increased until finally in 1929, all were joined together to form the largest electric system in point of kilowatt-hour output in the world—the Niagara Hudson System.



Water, entering the forebay, flows down pipes known as penstocks, and enters the turbines, pushing against the buckets of the turbine wheels.

THE MODERN GENERATING PLANT

THE PRESENT Schoellkopf Station, built in three sections known as A, B, and C, illustrates the development of engineering progress during recent years. The first section, built from 1905 to 1914, contains thirteen 10,000 horsepower horizontal shaft turbines. Section B, constructed from 1918 to 1920, is composed of three 37,500 horsepower vertical shaft turbines, while the last addition, or Section C, was built from 1921 to 1924 to house three 70,000 horsepower vertical turbines. The total installed capacity of the station is 452,500 horsepower.

Water, diverted for power purposes from above the rapids of the Upper Niagara River, is routed through two different channels to the Schoellkopf Station. The old hydraulic canal, first projected by Augustus Porter, is about 4,500 feet long and cuts diagonally across the city proper to bring water to the generators located in Sections A and B.

At the time of the construction of Section C, a tunnel, 4,400 feet long and 32 feet in diameter was driven through solid rock to bring water from the upper river directly below the City of Niagara Falls to supply the three 70,000 horsepower turbines in Section C.

At the Schoellkopf Station, the water enters a forebay. Here it flows downward through pipes known as penstocks, where it then enters the turbines, pushing against the buckets of the turbine wheels and causing them to revolve. The water then discharges into the river below the Falls at a level about 217 feet below the forebay.

The shaft of the turbine is connected directly to the shaft of a generator which drives electro-magnets past coils of wire in the stationary part of the generator. This produces electric current.

But the amount of water taken from Niagara River under acts of New York State Legislature and under the Boundary Waters Treaty between Great Britain and the United States is not enough to serve the present and future needs of Niagara Hudson customers.

While the Schoellkopf Station is the largest hydro plant in

the system it is now but one of the links in the chain of ninety-three hydroelectric stations, which, together with seven steam-electric plants, are all interconnected by transmission lines in one efficient group, to furnish constant reliable service to 700,000 customers in New York State.

Other hydro plants located further upstate on Adirondack streams deliver continuous power during the early spring and rainy seasons to supplement the output from Niagara's hydro plants. During other periods these hydro plants with their reservoirs can deliver maximum amounts of power during heavy load periods and can be used separately, if necessary, to carry the loads in the areas near the plants during periods of emergency.

Through the web-like transmission system, power generated at Niagara Falls may be delivered to remote farms in the most isolated sections served by the system. Should an emergency arise in any one plant, a ready supply of power is available through interconnection with plants in other parts of the system—a far step, surely, from the day when Chabert Joncaire marched forth with spade in hand to dig himself a mill race.

But even supplementary hydroelectric power is not enough. Steam plants, such as the 622,000 horsepower Charles R. Huntley station, situated just north of Buffalo on the Niagara River, and the new 107,000 horsepower steam station in Oswego, New York, are also necessary to supply all the power demanded by customers.

At the Huntley Station, for example, coal is received down the river in boats, or over land by train, and is placed in huge storage piles outside the station. Great scoops feed it into the plant where it is automatically weighed, pulverized as fine as talcum, mixed with air and blown into the furnace under pressure. There coal burns like gas, in quantities as large as 112 carloads per day. In immense boilers, as big as a five-story building, the water is converted into steam which drives 100,000 horsepower turbines — greater in capacity than those at Niagara Falls.

TRANSMISSION AND DISTRIBUTION

THE PATH of electricity from the generating plant to the customer's switch is long and complicated. Generated at comparatively low voltage (from 2,200 volts to 13,000 volts) part of the power is immediately sent to nearby customers. Another part passes through transformers where it is stepped-up to a higher pressure (from 66,000 to 110,000 volts) for long distance transmission.

Cables, of copper or aluminum, carry the electricity at high voltage throughout the state. Thousands of towers guide and millions of porcelain insulators guard it on its way to local substations.

When a city or load center is reached, the voltage is stepped down through a substation to suit local conditions. Before it enters the home or factory, however, it goes through another transformer and is reduced again, this time to the voltage required at the actual point of service.

Twenty-four hours a day this huge network of transmission lines, towers, substations and transformers must be kept alive with electricity, whether it is used or not. Further, Niagara Hudson must have capacity available at all times, not only for the customer who expects unlimited electricity at the touch of a switch, but as a guarantee for the future expansion of industry, and for those rare occasions when a large unit is out of service for repairs.

Transmission lines carry electricity at high voltage through the State.

SERVICE

TWENTY-FOUR hours a day!

In the home. Turn on the electric heater, the nursery's cold! Turn on the radio, I want to hear England! Turn on the vacuum, I want to clean the rug . . .

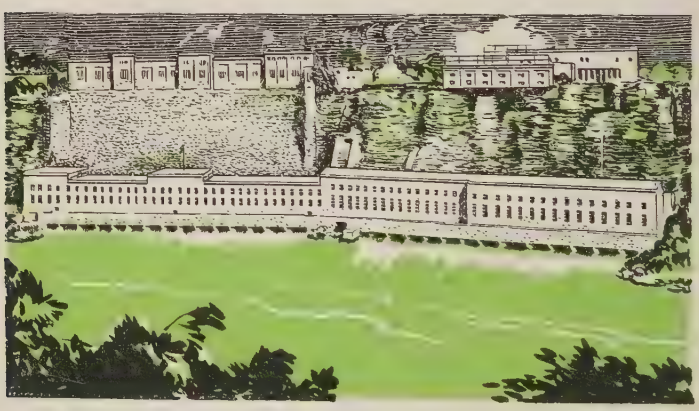
On the farm. Turn on the barn lights, we're going to milk the cows! Turn on the fruit grader, we're going to sort the fruit! Turn on the churn, we're going to make butter . . .

In the city. Turn on the pumping station, the city needs water! Turn on the beacons, a plane is coming in! Turn on the factory wheels, new tools are being made . . .

Tirelessly, endlessly, the great turbines spin!

Tirelessly, endlessly, the service moves with them!

Telephone operators answer the calls, and service trucks move out through cities, towns and hamlets. New equipment, transformers, lines and insulators to be installed for new customers, improved service for the old. Overhead on poles and towers, underground in cable manholes, no matter how trying the weather or difficult the task, lines are kept energized at all times. Surveyors, construction men, linemen, engineers! All of them working constantly so that those living in the territory served may have dependable low-cost electricity.



The present Schoellkopf Station illustrates the development of engineering progress through the years.

POWER

HENNEPIN to Joncaire . . . Joncaire to Porter . . . Porter to Woodhull . . . Woodhull to Day . . . Day to Schoellkopf . . . Schoellkopf to Adams . . . Two hundred years of effort . . . Two hundred years of toil . . . Two hundred years of dreams.

But where there is falling water, there is power.

Where there is power, there are men.

And Niagara Hudson power is a story of men; indomitable, courageous and far-seeing men . . . men who kept their faith in the face of prejudice and lack of funds, believing always in their dreams, persisting in their quests, investing their fortunes, their youth and age until at last their pioneer's task was done.

The nation owes its gratitude to the success of these men; for such success has meant a better state and more comforts for its citizens, a happier people.

For men's minds, stimulated by the opportunities opened by cheap, flexible power, turned to the task that has become peculiarly America's; the lightening of labor through labor saving devices affecting the home, farm and factory.

Go where you will today, there will be few moments in your life that are not directly touched by Niagara's pioneers. The machines that make your clothes, the welding of your bed springs, your radio, electric range, kitchen mixer; the forgings of your car, your knives and forks, your newspaper and book, the common tools of life . . . all these are results of the development of quantity transmission of power.

Power for all, power to build up the country, power to turn the wheels of industry!

Audacious, fearless, bold, they pressed forward, against the skepticism of others, contributing their money and brains until at last a switch was thrown and across twenty miles of land, the twin miracle of light and power answered the call.

That was long ago. Today the singing hum of great generators, mightier than any that had gone before, turn the wheels of life and labor, as long ago Joncaire's mill wheel spun the first song of Niagara Power.

GLOSSARY

Some Practical Electrical Terms

ALTERNATING CURRENT—An electrical current which alternately flows in opposite directions in an electric circuit.

AMPERE—Unit by which the flow of current is measured. Named for André Marie Ampère, 1775-1836, French physicist, mathematician and philosopher.

CYCLES—The number of times per second alternating current completely reverses the direction of its flow.

DIRECT CURRENT—An electric current which always flows in one direction in an electric circuit.

FOREBAY—A pond or reservoir of water from which water is supplied through penstocks to the hydraulic turbines.

GENERATOR—A machine for converting mechanical power into electrical power.

HORSEPOWER—A rate of doing work. An Electrical Horsepower equals 746 watts or approximately three-quarters of a kilowatt.

HYDRAULIC TURBINE—A machine which produces mechanical power by utilizing the energy given up by water flowing from a high elevation to a lower elevation.

KILOWATT—1,000 watts.

KILOWATT-HOUR—Equivalent to one hour's use of 1,000 watts or one kilowatt. For example, 100 watt lamp burning for 10 hours.

KILOVOLT—1,000 volts.

PENSTOCK—A pipe for delivering water to a hydraulic turbine.

TRANSFORMER—An apparatus for changing the voltage of an alternating current supply.

VOLT—Unit of electrical pressure which makes the current flow. Named for Alessandro Volta, 1745-1827, Italian physicist.

WATT—Unit by which rate of use of electrical energy is measured. Named for James Watt, 1736-1819, Scotch engineer and inventor.

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